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## THE ESTABLISHMENT OF THE PAPER NEST WASP IN WESTERN AUSTRALIA

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Early in 1950 Mr. A. Main reported that a colony of Paper Nest Wasps had been discovered at the Zoology Department of the University of Western Australia. The interest roused by this find led to publicity being given to the new arrival, an appeal being made for information on the presence of any other nests. This resulted in additional colonies being located, as described by Mr. L. Glauert (*W.A. Naturalist*, vol. 2, 1950, p. 139).

This article is an attempt to bring all the known information together and to present a theory as to the arrival and dispersal of the insect. Since it is easily recognised by the layman, it offers an excellent opportunity to study the spread of an introduced species and it is hoped that a continuous study of the wasp will be made over the next few years. The original home of the species is in the Eastern States.

### DESCRIPTION

The species was identified as *Polistes variabilis*, whose habits have been described as follows by K. C. McKeown (*Australian Insects*, p. 189):—"These wasps construct mushroom-shaped nests of wasp-paper, suspended from the dome by a slender stalk; the cells are arranged in regular order on the under surface, like those in a honeycomb. The fertile female, after overwintering, sets to work in the spring to construct the first few cells, the foundation of the future colony. She scrapes wood fibres from the surface of weathered posts or tree trunks with her mandibles and mixes them with saliva into a coarse brown paper-like material which she uses to construct the nest. The wasp was the world's first paper-maker! The foundation female or queen, carries out all the necessary work in the nest, depositing the eggs and feeding the young larvae; when the first adult workers emerge, they take over these duties, with the exception of egg-laying, a duty to which the queen now devotes her whole time. With the growth of the colony, the nest increases in size by additions of cells to the outer edge. A large nest may measure up to about nine inches in diameter. The workers are aggressive and will attack the intruder with little or no provocation. If disturbed in any way, the wasps will all face outwards, elevate their wings, and raise themselves high upon their legs in preparation to attack. The stout,

white legless larvae are suspended from the roof of the cells, and the workers crawl about over the surface of the comb feeding the larvae with the masticated flesh of caterpillars. This devotion to the young is not wholly disinterested, for the larvae emit a fluid from the mouth, which is relished by the workers, who receive this liquid in exchange for the food they offer. The process is known as trophylaxis. When the larvae are fully fed, they spin a silken screen over the mouth of the cell before pupating. Late in the season the males appear, and their duty is the fertilisation of the females who will subsequently overwinter, and become the foundresses of new colonies in the following spring. With the coming of winter the colony declines, although a vain effort to prolong its life may be made by the dwindling workers who drag the younger larvae from their cells and feed them to the older individuals, but within a few weeks at most all are dead."

As will be seen later variations from this pattern have been obtained.



Fig. 1.—Nest in the frond of a palm at Subiaeo.

Photo V. N. Serventy.

## NESTING LOCALITIES DURING 1949-50 SUMMER SEASON

Nest 1. Zoology Department, Crawley. This was built under the top window ledge at the first floor level. The window faces north. Individuals from this nest were seen flying to the top of a eucalypt nearby, but the food being obtained was not ascertained. The following season the same nest was again active.

Nest 2. Churehill Avenue, Subiaco. This was collected and is now on display at the W.A. Museum.

Nest 3. Children's Hospital, Subiaco. This was collected, placed in a paper bag and brought to the Museum. The docility of the insects is indicated by the fact that the collector was not stung.

Nest 4. 48 Bagot Road, Subiaco. This was left untouched and was in full occupation the next season. However, during the winter it appeared to be deserted according to the report of a nearby resident. Probably individual wasps would be sheltering above the comb.

Nest 5. 53 Ord Street, West Perth. This colony was first observed in October 1949.

Nest 6. 39 Beatrice Road, Dalkeith.

Nest 7. 11 Vale Road, Mount Lawley.

Nest 8. 14 Outram Street, West Perth. This was described by E. L. Carthew (*Wild Life*, vol. 12, no. 10, 1950, p. 469) and contained approximately 100 cells.

Nest 9. 68 Coghlan Road, Subiaco. This was built on a vertical piece of wire netting and the mushroom shape was not apparent. Again there was a fence giving protection from the south.

Nest 10. South Perth.

Nest 11. Crawley.

Nest 12. Allen Street, East Fremantle. This nest was situated on a wall and under shelter, the whole having an eastern aspect. The colony contained 378 wasps.

## OBSERVATIONS AT NEST 12.

Nest 12 was removed from East Fremantle to Midland Junction on April 12, 1950 and notes kept of its subsequent history. In spite of all care a heavy mortality occurred during the transfer, 118 of the 378 wasps dying. Cold weather following caused a steady diminution of numbers. The wasps would not leave the area and if dislodged would not regain the nest nor would they fly.

May 15. 17 wasps at nest. These were both males and females.

June 18. Noticed some eggs in cells. There was little activity and no aggression.

July 3. No development in the eggs. 28 wasps but still some males.

July 13. In a crevice near a verandah post 11 wasps were found sheltering and at least two were males.

July 28. A pedicel and one cell found about 15 feet from the old colony. Wasps were in attendance.

August 3. The nest now contained five cells, three of which had eggs. The primary nest had larvae and the wasps at both nests were aggressive.

September. The larvae in both nests developing, the new nest now containing 14 cells and being tended by three wasps.

October 20. The first cell in the old nest covered.

October 28. The activities of a spider caused a high mortality in the original nest and this colony now only had 7 wasps. On the same day the first cell was closed in the new nest.

November 8. The new nest now had 30 cells.

November 18. The spider had completely covered the old nest with web.

December 8. The first young emerged from the new nest. The total number of wasps was now 9.

December 18. A young wasp was seen emerging. From the time of clearing the cap to complete exit, was approximately two minutes. The insect stood for a few minutes with beating wings.

December 20. All cells clear or containing eggs or larvae. First to emerge were workers or small females but two males were present.

January 6. Cells recently quitted now have eggs.

January 8. Only four wasps left. Either heavy mortality or voluntary withdrawal. The adults left included one male.

January 15. 4 wasps in attendance. 1 cell covered while others contain larvae. Adult wasps have been noticed on lantana some 500 yards from the nest.

The details given indicate that the local wasps are showing some considerable variations from the habits as established for the same species in the Eastern States. In this connection it is interesting to note that A. D. Imms (*Social Behaviour of Insects*, p. 31) speaking of the genus *Polistes*, says: "In tropical countries the colonies tend to be polygynous or in other words they are founded by a number of queens. The warm equable climate, coupled with a sufficiency of food at all times of the year fosters the survival of the colonies from year to year. Unlike species found in temperate regions, certain of the tropical forms periodically give off swarms."

It is an interesting possibility that the species may have a similar behaviour pattern as in the tropical form, but only in our environment were conditions favourable enough for the full pattern to be displayed.

#### FOOD

With regard to diet we have observed little as yet, though the University wasps did fly in a constant stream to the top of a Marri (*Eucalyptus calophylla*) nearby.

M. N. Brewster, A. N. Brewster and N. Crouch (*Life Stories of Australian Insects*, p. 145) give the following details with regard to *Polistes humilis*:—"These wasps seem to have adapted themselves to a mixed diet, for though normally they feed their larvae

on masticated caterpillars, the same larvae have been reared in the later end of their life on vegetarian diet. Also the adults feed on nectar of flowers, on juices of fruit."

#### ARRIVAL AND DISPERSAL

The following theory has been advanced to account for the arrival and dispersal of the Paper Nest Wasp.

Fig. 2 shows the nests to be roughly spread on a line trending N.E. and S.W. Springtime would appear to be the period for exploratory movements on the part of fertile queens and Fig. 3 indicates that the strongest and most constant wind at this time is from the south or the south-west. It would appear therefore that the insects are wind dispersed. This would put the first colony at Fremantle. Since this is also the main port for Western Australia it favours a ship as the agent bringing the insect here. It is interesting to note that P. Crosbie Morrison mentions that a closely related species was introduced by ship to New Zealand (*Wild Life*, vol. 12, no. 10, 1950, p. 470).

However the insect could have been brought either by land or air. All that would be necessary in the first place would be the arrival of a fertile female.



Fig. 2.—Nesting localities of Paper Nest Wasp, 1949-50 season.

The cluster of individuals at Subiaeo would seem to indicate that this is the result of a spread from an original colony at the same place. It would be too much of a coincidence to expect that a number of insects would be blown from Fremantle to the one spot in Subiaeo. The experience at Midland Junction indicates that daughter colonies are established near the parent colony. Wind dispersal may only come into play when the environment proves unsuitable and the queens begin to explore further afield.

If the above reasoning holds good this would place the first arrival, or at least the setting up of a colony, in the spring of 1947. In the autumn of 1948 individuals would rest over the winter and in the spring spread further afield, probably along the S.W. to N.E. line. One queen landing near Subiaeo would establish a colony which would be the nucleus for the new dispersal in the spring of 1949. This would explain the large numbers of colonies in this area discovered in the summer of 1949-1950.

The authors are only too well aware of the very slim basis on which the above theory has been built. At present further investigations are being carried out on the details of the life history. It is hoped that the publication of these notes will stimulate other observers to watch the insect. It is also hoped that any readers who know of a Paper Nest Wasp colony will contact the authors so that its position and history can be recorded.

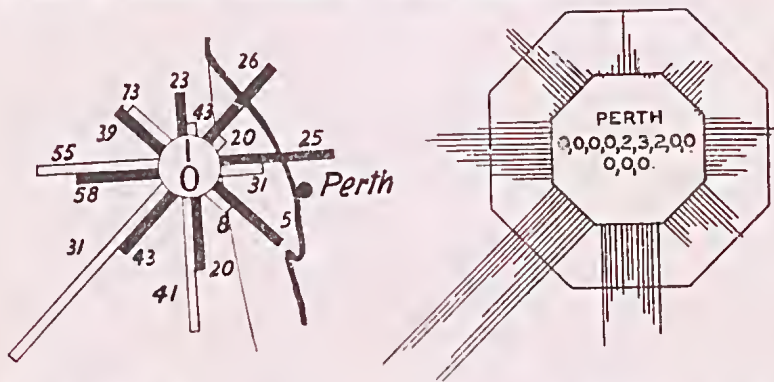


Fig. 3.—Wind Roses for the Perth district. Left, wind rose for the spring months, September, October and November (the lengths of the bars are proportional to the relative frequencies of the various directions, the direction of the wind being towards the centre of the rose; full black bars give the morning winds and the open bars the afternoon winds; the numbers on each bar indicate the percentage of winds from the particular direction which exceed 20 m.p.h.; the figures in the centre circle represent the percentage of calms, morning on top, afternoon below). Right, wind rose showing monthly frequency distribution of wind directions at 3 p.m. (the sides of the octagons face towards the cardinal and semi-cardinal points; the twelve lines projecting from each side represent the months of the year, working round clockwise from January to December, and their lengths are proportional to the frequencies of the winds; the figures give the percentage frequency of calms.—From Commonwealth Weather Bureau Charts.